

Operating Experience Summary



Office of Nuclear and Facility Safety

May 26 — June 16, 2000

Summary 2000-11

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EVENTS

1. UNPLANNED ELECTRICAL WORK COMPROMISES PERSONNEL SAFETY

On May 23, 2000, at Idaho Falls, a day shift utilities foreman discovered that the subcontract pipe fitters had incorrectly cut two 110-volt electrical conduits without a lockout-tagout (LO/TO) during demolition work in the boiler house. The circuit breaker happened to be open and no one was injured. Work on electrical circuits without positive control such as a formal lockout and tagout constituted a near miss and presented a potential hazard to the workers. (ORPS Report ID--BBWI-LANDLORD-2000-0017)

Investigators discovered that the subcontract pipe fitters were tasked only with removal of pipes in front of the two boilers and that the electrical work was assigned to another subcontractor. The pipe fitters performed unauthorized electrical work by cutting electrical conduit and removing the boilers' sight glass lights. Investigators also determined that the details of demolition work on the drawing provided by the utilities operations personnel to the subcontract foreman were vague and did not identify specific work areas.

Multiple violations of safety barriers contributed to this occurrence.

- **Job Planning.** The pipe fitters did not use a systematic process to positively identify piping sections scheduled for removal.
- **Zero Energy Check.** The workers did not check whether the lockout/tagout was installed to eliminate hazardous energy in the work area.
- **Safety Controls.** The primary contract supervisor did not implement proper controls for coordination between the current pipe fitters' work and the subsequent electrical subcontract.

The facility operations supervisor took the following immediate actions.

- Construction work was stopped.
- A lockout/tagout for the affected electrical circuit was issued.
- A walkdown of the construction work area was performed to identify any systems requiring lockout/tagout prior to resumption of work.

In another event on May 23, 2000, at Savannah River, a construction subcontract crew inadvertently cut a 120-volt electrical cable in a conduit that fed power to a tank annulus continuous air monitor fan motor. This section of the electrical system was de-energized under a previous lockout/tagout for an electrical and instrumentation upgrade. The task involved removal of conduits and cables as part of demolition and removal work. The workers were using appropriate insulated protective equipment. No one was injured, but the unapproved work on the power cable without a thorough zero-energy check exposed the crew to serious safety hazard. (ORPS Report SR--WSRC-HTANK-2000-0026)

In this event investigators determined that work package did not highlight the conduit to be removed. The work team used an informal blue flag field identification system to assist the electricians in locating the conduits to be removed, but additional photographs would have confirmed their location. Investigators also determined that the crew conducted a proper zero energy check on the first circuit they removed by checking the panel with the proper instrument, but then failed to use the meter to check the second panel they were working on. Instead they used a proximity meter on the conduit. Site directives allow the proximity meter only as a backup after using a contact meter for voltage checks. The workers used the contact meter only in the first panel. One worker saw sparks when cutting the conduit with a reciprocating saw. He stopped and notified his supervisor and the Subcontract Technical Representative immediately. Investigators conclusively determined that the pre-job briefing was thorough, but the electricians did not pay attention to details.

- **Hazards Analysis.** The barrier analysis indicated that the failure to perform a zero energy check on the circuit was the main safety violation.

- **Hazard Controls.** Controls to mitigate the unapproved work were not in place and there were no steps taken to identify the potential for inadvertent cutting of power cables.

Facility management took the following immediate actions.

- Secured the Annulus Fan.
- Stopped all work.
- Locked the circuit breaker open.
- Verified the absence of voltage and taped cut wires.
- Barricaded access to the area during restorative repairs.

EH engineers have reported similar occurrences

- Operating Experience Summary 99-40 reported that on September 29, 1999, at Argonne National Laboratory-West, two electricians violated a work package requirement when they disconnected a push button to relocate it on an auxiliary boiler alarm/control panel without de-energizing the panel and applying a lockout/tagout to its power supply. (ORPS Report CH-AA-ANLW-ANLW-1999-0007)
- Operating Experience Summary 99-30 reported that on July 21, 1999, a shift manager at the Savannah River F-Area Analytical Laboratory discovered that an engineer had performed electrical work three days earlier without obtaining an electrical lockout. During startup testing for an instrument air compressor cooling system modification, the engineer had replaced fuses in a 208-V ac control panel, installed electrical jumpers, and lifted and remanded motor leads. He had also used his personal voltmeter to take voltage readings. (ORPS Report SR--WSRC-ALABF-1999-0017)

These events underscore the importance of Job Hazard Analysis and Hazardous Energy Control for safe conduct of operations. Working on potentially hazardous systems or components without a safety lockout is a serious safety violation, because it bypasses all administrative barriers intended to prevent personnel injury. It is also one of the most common violations and difficult to prevent. Safety depends heavily on workers' knowledge of safety requirements, continuous attention to detail, and personal commitment to safety. The following publications provide guidance on control of hazardous energy for safe operations at DOE facilities.

- 29 CFR 1910, *Occupational Safety and Health Standards*.
- DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*.
- DOE/EH-0540, Safety Notice 96-05, *Lockout/Tagout Programs*.
- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*.

KEYWORDS: inattention to detail, lockout and tagout, conduct of operations

FUNCTIONAL AREAS: Electrical Safety, Industrial Safety, Job Hazard Analysis

2. DEFECTIVE AIR LINE FILTERS DISCOVERED

On May 12, 2000, at the West Valley Demonstration Project, operators discovered a potential defect with certain Series 41 AF Bullard air-line filter cartridges. Operators noticed that Bullard filters labeled SO#80929 rattled when shaken, and when they opened one to investigate the source of the noise, they discovered that the uppermost filter and wire mesh screen had been creased underneath the plastic top cover. Operators also noticed that the contents of the filter appeared to be mixed together rather than separated in distinct layers. Facility management contacted the manufacturer and removed all Bullard filters labeled SO#80929 until they could determine whether the damaged filters could affect air quality. Defective air filters can render personnel vulnerable to harmful air quality. (ORPS Report OH-WV-WVNS-CF-2000-0004)

The manufacturer has accepted responsibility for the problem and has stated that the defect stems from incorrect packing of the top carded cotton filter. Figure 2-1 shows Filter Model 41AF, and Figures 2-2 and 2-3 show the filter cartridge and the inside of the filter housing. The manufacturer also stated that breathing air quality would not be

compromised as a result of this defect but agreed to replace the defective filters. The manufacturer sent a letter to the West Valley Demonstration Project acknowledging the problem filters and stated that they have taken corrective action to eliminate future occurrences. For further information about the defective filters, contact Jay Parker, the manufacturer's representative, at 1-800-227-0423. For additional information regarding the West Valley Demonstration Project call Carol Schmeidler at 716-942-2086. There were no injuries associated with this event.



Figure 2-1. Bullard Air-Line Filter Model 41AF

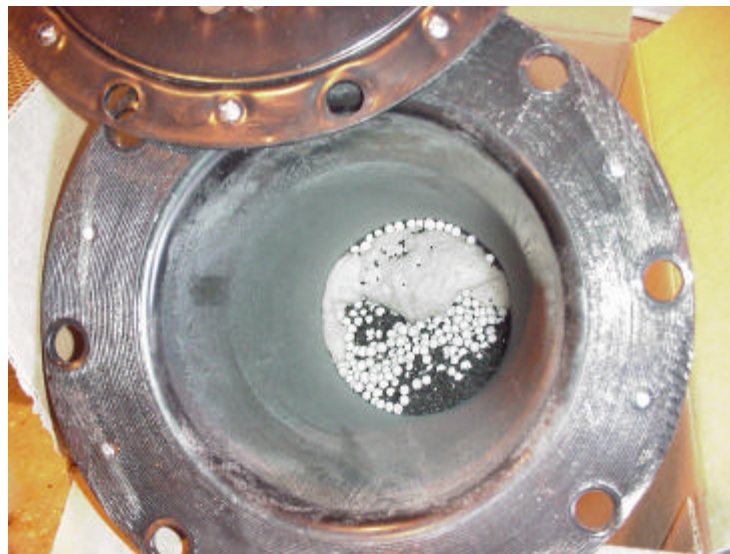


Figure 2-2. Inside View of Filter Model 41AF



Figure 2-3. Filter Model 41AF Showing Filter Media

KEYWORDS: air filter, air quality, defective filter

FUNCTIONAL AREAS: Industrial Safety, Hazards and Barrier Analysis

3. CHEMICAL REACTION CAUSES FIRE

On May 23, 2000, at Oak Ridge, straw bales and 4" x 4" wooden stakes stabilizing plastic sheeting covering a 20 ton pile of lime pellets caught fire. The fire department and emergency response personnel responded to the scene. They allowed the fire to burn out after confirming there was no radioactive or hazardous release. There were no personnel injuries or equipment damage except for the loss of eighteen straw bales and three sheets of 10mil plastic. Imprudent storage of chemicals capable of an exothermic reaction upon exposure to water can lead to personnel injury, radioactive contamination or hazardous release. (ORPS Report ORO--BJC-X10ENVRES-2000-0012)

Investigators determined that a subcontractor conducting a remedial activity involved mixing quick lime/calcium oxide pellets into the Process Waste Sludge Basin (PWSB) to stabilize its radioactively contaminated sediments. Lime (CaO, quicklime) is exothermically reactive on contact with water, and was stored near the basin within layers of plastic to protect the lime pellets from rainwater. The plastic was contained within a U-shaped berm constructed of straw bales. Following a severe morning thunderstorm, smoke was observed originating from the PWSB area. Straw bales were burning when the ORNL Fire Department arrived. The fire was confined to the straw bales, which were not contaminated. An air monitor registered normal background radiation levels.

The lime material, remaining straw bales, and ashes were transferred into the basin after the fire burned out in order to prevent additional problems from forecast afternoon thunderstorms. A fire watch was maintained for 4 hours to certify stable site conditions. The lime has been safely stored within the basin since the incident, uncovered and in contact with the elements, with no negative impacts. Investigators found that the primary cause for the fire was the presence of combustible material in proximity to the lime pellets, and the addition of water.

Several causal factors for the fire were discussed during a root cause analysis as follows:

- The work plan identified the laydown area but neglected specifics relating to material containment;
- The original plan for shallow pit storage was modified to above-grade storage to reduce expense and lengthy delay in construction;
- The use of straw bales to support the plastic covering on the lime violated storage requirements in the Material Safety Data Sheet;

- The hazard analysis was incomplete; it focused on the use of the material, with little attention to storage requirements;
- Daily lime deliveries in such large quantities created a storage problem, which had not been analyzed.

Corrective actions identified from the causal factors follow.

- A lessons-learned summary will be developed stressing the need for complete hazards analysis.
- The containment structure for storing the quicklime will be redesigned with non-combustible materials.
- The project team will communicate better with the fire department about posted hazards at the site for future projects.

The subcontractor proposes to hold the lime in a flame resistant tarp contained within a short concrete block berm (no more than four blocks high, not grouted) then covered with plastic. The contractor is instructed to transfer surplus material into the PWSB prior to close of business on the day of delivery. The area will actually be used as a receiving area instead of a storage area. Under certain circumstances, the contractor may contain some of the quicklime in the redesigned receiving area as a backup only. Temporary storage in this area will require written approval from site management.

KEYWORDS: Chemical fire, quicklime, exothermic reaction

FUNCTIONAL AREAS: Decontamination/Decommissioning, Fire Safety, Chemical Handling

4. TWO INCIDENTS INVOLVING VEHICLE EQUIPMENT PROBLEMS

On June 1, 2000, at Weldon Springs, an equipment operator's arm was singed when hydraulic fluid caught fire on the sheepsfoot compactor he was using at the Quarry Area. The operator was examined by the site nurse, deemed unhurt, and released. On June 2, also at Weldon Springs Quarry Area, a teamster driving a "Gator" (6-wheel utility vehicle- see figure 4-1) to transport an operator to his trackhoe, sustained a leg fracture when the Gator rolled over on the driver's side and pinned his leg. The teamster was taken to the hospital by ambulance, treated for a fracture to his left leg above the ankle, and released the same day. The fire at the compactor was declared a design fault by the manufacturer. The poorly located hydraulic hose was replaced by a manufacturer's representative and tied off to prevent recurrence of the incident. Mechanical equipment failures can lead to property damage and worker injury. (ORPS Report ORO--MK-WSSRAP-2000-0013)

In the first event, investigators determined that an improperly located hydraulic hose had become worn from rubbing on a solenoid for the compactor's ignition system. The hose suddenly ruptured, leaking hydraulic fluid on the hot solenoid. A spark from the solenoid ignited the hydraulic fluid, sending flames approximately eight feet high on the right side of the vehicle, engulfing the fire extinguisher. The operator turned off the ignition, unfastened his seat belt, and dismounted from the left side. The flames had gone out by the time the operator walked around to the right side of the vehicle. Approximately 15 gallons of hydraulic fluid leaked from the compactor and were contained. A wire connecting the operator's belt-worn noise dosimeter to a sensor on his collar was scorched. The short fire did not damage the compactor. It was returned to service after the damaged hydraulic hose was replaced.

EH Engineers have reported similar occurrences involving vehicle mechanical failures:

- Operating Experience Summary 2000-08 reported that on April 6, 2000, at Savannah River, a Bechtel Savannah River Company construction employee attempted to extinguish a fire that consumed a gas-powered golf car utility truck that he was operating. The construction employee was not injured, but the utility truck was a total loss. Contractor management reported this fire because this was the second fire in their fleet of golf car utility trucks in 8 months. (ORPS Report SR--WSRC-CSWE-2000-0009)
- Operating Experience Summary 96-15 reported that on April 7, 1996, at the Savannah River H-Area Tank Farm, a maintenance mechanic lost control of a Cushman utility vehicle when mechanical failure of the accelerator linkage caused the throttle to stick in the full open position. The driver was making a left turn at the time of the failure and was unable to negotiate the turn because of the high speed. The vehicle rolled over on the passenger side, resulting in a strained back for the passenger. The driver was unhurt. Investigators believe the accident may have been caused by the failure of a weld in the accelerator linkage. (ORPS Report SR--WSRC-HTANK-19960008)

In the second event, investigators learned that a laborer trying to drive the Gator that morning found the accelerator cable disconnected. Instead of logging the vehicle out of service for repair by qualified and trained maintenance personnel, the laborer reconnected the cable. A teamster driving the Gator delivering a trackhoe operator (passenger on the Gator) hit a dirt clump with the right front wheel of the vehicle while approximately eighteen inches up the dirt ramp where the trackhoe was located. The Gator rolled onto the driver side, pinning the driver's left foot under the gator. The trackhoe operator unbuckled his seatbelt, fell onto the teamster, then on the ground outside the Gator, and righted the gator to free the teamster's foot. The teamster was conscious, complained that the gas pedal had stuck on the gator, and indicated that his left ankle was hurt. The operator tried to radio his superintendent, but got no reply because the radio was in a reception dead zone. Under instructions not to move an injured worker, the trackhoe operator ran about 100 feet down the embankment to the superintendent and a subcontractor aid station to get help. Two laborers went up the hill to the accident scene where the teamster lay face down on the ground. One of the laborers drove the Gator to the entrance of the Quarry Area to await an ambulance and direct emergency vehicles to the accident scene. The subcontractor used heavy equipment to prepare the excavation area for vehicle access to evacuate the injured teamster.



Figure 4-1. Gator Utility Vehicle

An event review meeting revealed several issues in the Gator rollover incident.

- Equipment needing repair (the Gator's disconnected accelerator cable) should be tagged, taken out of service, and repaired by qualified and trained personnel. A supervisor was not notified that the Gator needed repair earlier that day.
- The subcontractor is unable to provide documentation that all operators of the Gator were familiar with the vehicle operator's manual.
- The route of travel taken by the teamster to deliver the trackhoe operator was inappropriate and unnecessary. A gator was not needed in the Quarry Area.
- Use of the Gator to flag down and direct the emergency response unit vehicles compromised the accident scene.
- The subcontractor superintendent who escorted the injured employee to the hospital emergency room failed to order a post accident drug screening.
- The injured employee's statement was not taken until 6 days after the event.

These events underscore the need for constant vigilance and attention to detail in vehicle maintenance and operation. In the first event, alert observation of the vehicle during regular maintenance or operation may have revealed the rubbing hose before it failed. In the second event, a number of conduct-of-operations failures led to an injury.

KEYWORDS: Gator, sheepsfoot compactor, hydraulic fluid

FUNCTIONAL AREAS: Construction, Maintenance, Worker Safety

5. UNINTERRUPTIBLE POWER SUPPLY SHORT-CIRCUITED DURNG MAINTENANCE

On May 18, 2000, at Hanford, an electrician performing routine maintenance contacted two terminals of an uninterruptible power supply (UPS) with a torque wrench creating a short circuit that resulted in an electrical arc. The worker was not injured, but the torque wrench and points of contact were damaged and the UPS will need repair. Failure to recognize all of the hazards of a work assignment can result in equipment damage and serious worker injury. (ORPS Report RL--PHMC-PFP-2000-0014)

Investigators determined that two electricians were performing routine semi-annual preventive maintenance on a 420-VDC uninterruptible power supply. They were checking voltage and bolt torque on the battery terminal posts of all 30 battery cells. When the electrician turned the torque wrench to check battery connection torque on one of the cells, the wrench contacted the battery system fuse block approximately eight inches above the battery cell. There was a 420 VDC arc, a flash, smoke, and a splash of metal particles onto the electrician's shirt, badge, and several battery cells. The arc melted the handle of the torque wrench and welded the socket to the bolt. The electrician was wearing a pair of leather gloves and had appropriate eye protection. He was tall enough that his head and neck were above the battery system fuse block, and thus not in the blast zone. His height also protected him from flash burns.

This electrician had performed this same maintenance operation several times in the past without incident. Potential work hazards were discussed during an informal pre-job meeting. The procedure was read and the necessary tools and personal protective equipment were reviewed. The pre-job review indicated that a maximum of 3 batteries, or 36 VDC, would be the hazard. A warning in the procedure indicates that voltages above 50-VDC may be present in the UPS with or without AC input connected. The potential for exposure to 420 VDC was not well described in the documentation for the work. A formal job hazard analysis was not performed prior to the work. The electricians notified the building emergency director responsible for the entire facility, the station operator, and operations manager before beginning work. The short-circuit would have caused an alarm, but since the unit was off-service for the maintenance no alarm was generated. The stationary operating engineers were not notified after the event that the UPS had been damaged and was inoperable.

Corrective actions from this incident:

- The welded socket will be removed and the affected battery cell removed and replaced.
- The procedure will be revised to stipulate use of an insulated short throw torque wrench. The facility does not currently own one of these tools.
- The maintenance check will be redone to determine if any other battery cells are damaged beyond the cell shorted.

EH Engineers have reported similar occurrences involving electrical arcs in the following Summaries.

- Operating Experience Summary 98-50 reported that on December 2, 1998, at the Rocky Flats Environmental Technology Site Broomfield Warehouse, an electrical engineer accidentally contacted an inadequately insulated 480-V cable connection with a clamp-on ammeter, causing an electrical arc and a blown fuse in the power distribution panel. The engineer was measuring current flow in surrounding components and was attempting to attach the ammeter when he contacted the cable connection and caused it to contact a metal wireway. When the ammeter contacted the bolted connection he heard a loud "pop" and saw a flash. Warehouse personnel secured the system power and notified the manager of the event. Investigators determined that because the warehouse is off-site and is not a DOE facility, no one implemented the necessary work control programs or safety measures. Although the engineer was not injured, no safety measures were in place to protect him from a fatal electrical shock or a severe flash burn. (ORPS Report RFO--KHLL-371OPS-1998-0085)
- Operating Experience Summary 98-27 reported that on June 12, 1998, at the Hanford Site Waste Encapsulation and Storage Facility, an electrician received burns to his left arm and hand when an electrical arc and flash occurred while he was working on a modification to a motor control center. The work package required the electrician to remove a door-operating mechanism from a spare circuit breaker. When he reinserted the screws holding the spare circuit breaker to its mounting plate, one of the screws contacted the line-side wiring behind the breaker and penetrated the wire insulation. The resulting short created metal ion vapor in the bucket area, resulting in the phase-to-phase fault and flash at an adjacent 480-volt circuit breaker that burned the electrician. (ORPS Report RL--PHMC-WESF-1998-0006)

KEYWORDS: Electrical arc, battery, uninterruptible power supply, torque wrench

FUNCTIONAL AREAS: Maintenance, Worker Safety

6. LOCKOUT TAGOUT FAILURE CAUSES NATURAL GAS LEAK

On June 7, 2000, at Los Alamos National Laboratory, natural gas was discovered leaking from an open one-inch gas line near an open window of an office building. Safety personnel in the building were notified, located the source, and ordered an evacuation. The release came from a service line that was believed to have been isolated during the recent shutdown due to the Cerro Grande forest fire. The gas escaped for about four minutes before it was isolated. No injuries occurred and the rapid evacuation and gas shutoff minimized the potential for ignition or injury. (ORPS Report ALO-LA-LANL-FIRNGHELAB-2000-0005)

Investigators determined that natural gas service was shut prior to site evacuation due to the Cerro Grande forest fire. The valves were closed and tagged with a red "Danger do not operate" tag. A local group of startup personnel opened a red tagged valve to supply gas to a heater, but they left the tag on the valve. The presence of tag on the valve would indicate that the valve was still shut as when the tags were applied during the evacuation.

Pipefitters initiated efforts to re-establish gas line integrity after the fire threat subsided. They began to pressure test sections of the lines, but did not institute a formal lockout tagout process. They had just finished testing a section of large diameter gas line and had removed a section of the one-inch line to use as a test port. They had left the open line in order to perform additional testing and believed that it was isolated from the gas by the red tagged valve. They restored gas to a section that was previously tested and were about 300 feet from the open line and out of sight from it. Office workers heard and smelled escaping gas and notified the building ES&H representative. The representative ordered an evacuation had a pipefitter shut the red tagged valve to stop the leak. The testing process was stopped and the formal laboratory lock/tagout process was initiated for the remainder of the gas line reactivation.

EH has reported several improper lockout-tagout events:

- On August 31, 1999, at the Pacific Northwest National Laboratory (PNNL), a pipefitter cut into a 3-inch carbon steel steam line that was pressurized with 100-psig compressed air. He immediately stopped cutting when he heard a hissing noise. The pipefitter was performing demolition work on what he believed was an abandoned steam line. No one on the building core team (building manager, facility project manager, and work control specialist) knew that another organization had modified the abandoned steam line for use as an air supply line, and no one on the core team had verified the status of the line before performing work. (ORPS Report RL--PNNL-PNNLBOPER-1999-0027)
- Operating Experience Summary 98-49 reported that pipe fitters at the Rocky Flats Environmental Technology Site loosened a connection to bleed off residual air in an air supply line and realized that the line was still pressurized and not locked out or tagged out. Investigators determined that no one had performed a system walk-down to ensure all system isolation points were identified and locked out and tagged out before the pipe fitters began work. (ORPS Report RFO--KHLL-771OPS-1998-004)

These events underscore the need for personnel to ensure that the lockout/tagout process is properly administered. Lockout/tagout holders should verify that the locks and tags have been correctly installed on the isolation boundaries in accordance with established procedures

Lockout/tagout programs in DOE serve two functions. The first function, defined in 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. A good lockout/tagout program is an important element of an effective conduct of operations program.

Facility managers are ultimately responsible for ensuring successful completion of work activities. Routine monitoring of contractor and subcontractor work by facility managers and supervisors will help ensure that maintenance activities are conducted in accordance with facility policy and procedures.

KEYWORDS: conduct of operations, maintenance, personnel error, procedures

FUNCTIONAL AREAS: Maintenance, Procedures, Industrial Safety, Hazards Analysis, Work Control